

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	TITLE PAGE	i
	DECLARATION	ii
	DEDICATION	iii
	ACKNOWLEDGEMENTS	iv
	ABSTRACT	v
	ABSTRAK	vi
	TABLE OF CONTENTS	vii
	LIST OF TABLES	x
	LIST OF FIGURES	xi
	LIST OF ABBREVIATIONS	xiv
	LIST OF APPENDICES	xvi
1	INTRODUCTION	1
	1.1 Background	1
	1.2 Problem Statement	3
	1.3 Research Objectives	5
	1.4 Research Scope	6
	1.5 Research Significance and Benefits	7
	1.6 Summary of the Thesis	8
2	LITERATURE REVIEW	9
	2.1 Introduction	9

	2.1.1	Raster Charts	11
	2.1.2	Vector Charts	11
	2.2	Electronic Chart	12
	2.2.1	Electronic Chart Display and Information Systems (ECDIS)	13
	2.2.2	Electronic Chart System (ECS)	14
	2.3	GIS in Hydrography Data Management	15
	2.4	Database Development Process	17
	2.5	Marine Spatial Data Infrastructure	19
	2.6	Hydrographic Information System	21
	2.7	Maritime Safety Information	22
	2.8	Marine Search and Rescue	24
	2.9	Global Maritime Distress and Safety System	25
	2.10	Scripting Language	26
	2.10.1	Microsoft Visual Basic	27
	2.11	ESRI MapObjects 2.4 Overview	27
	2.12	Summary	29
3		RESEARCH METHODOLOGY	30
	3.1	Introduction	30
	3.2	Preliminary Work	33
	3.3	Data Collection	36
	3.4	Software Exploration	37
	3.5	Database Design	39
	3.5.1	Conceptual Data Model	40
		3.5.1.1 Entity Model	40
		3.5.1.2 Relationship Model	41
		3.5.1.3 Attribute	41
	3.5.2	Logical Database Design	41
	3.5.3	Physical Database Design	43
	3.6	Development of Graphical Interface	43
	3.6.1	Element of Graphical User Interface	43
	3.7	Development of Maritime Rescue Application	

	System	44
3.8	Development of Menu and Sub-Menu	47
3.8.1	File Menu	50
3.8.2	View Menu	52
3.8.3	Marine Search Menu	54
3.8.4	Help Menu	59
3.9	Summary	61
4	RESULTS AND ANALYSIS	62
4.1	Introduction	62
4.2	Maritime Rescue Application System Display	62
4.3	System Evaluation	66
4.3.1	Testing the Map Tools Function	66
4.3.2	Testing of the Menu Bar Function	72
4.3.2.1	Add Layer	73
4.3.2.2	Remove Active Layer	74
4.3.2.3	Legend Editor	75
4.3.3	Evaluation of Marine Search Menu	77
4.3.3.1	Vessel Location Menu	78
4.3.3.2	Medical Assisted Menu	83
4.3.3.3	Fire and Rescue Menu	85
4.4	Summary	86
5	CONCLUSION AND RECOMMENDATION	87
5.1	Introduction	87
5.2	Conclusion	87
5.3	Recommendations	89
	REFERENCES	90-93
	Appendices A - F	94-171

LIST OF TABLES

TABLE NO.	TITLE	PAGE
1.1	Hardware characteristics	6
1.2	Software characteristics	7
2.1	Types of Paper Chart	10
3.1	Example of representing ER Conceptual Model	40
3.2	Lists of Logical Design	42
4.1	Toolbar function	67

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
1.1	Search and Rescue areas	2
1.2	Search and Rescue areas in Malaysia	3
2.1	A simplified database system environment (Source: Spatial with Database Application to GIS by Rigaux et.al., 2002)	19
2.2	A key principal of SDI is to publish data once and use many times (Source: IHO: Spatial Data Infrastructures “ <i>The Marine Dimension</i> ”, 2009)	21
2.3	MapObjects and ActiveX containers (Source: ESRI, 1999)	28
3.1	Research methodology flowchart	32
3.2	Results of the survey on managing data using Web-based GIS application	34
3.3	Results of Maritime Rescue Application System in the Marine Department	35
3.4	Results of the survey for maritime rescue information or data	36
3.5	Raster image of MAL 6128	37
3.6	Interface of Autodesk Map 2004	38
3.7	Interface of attribute data entry using ArcView 3.1	39
3.8	Entity Relationship Model	41
3.9	List of Component in Control Tab Menu	44
3.10	Map Control for MapObjects Visual Basic toolbox (Source: MapObjects, 2004)	45
3.11	Overall design of the system	46
3.12	Overall design of main the form	47

3.13	Architecture of the Main and Sub-Menu	48
3.14	Menu editor Interface	49
3.15	Interface of Property Pages from Image Lists	50
3.16	Sub-menu in the File menu	50
3.17	Add CAD Layer dialog box	51
3.18	Symbol Properties interface layer	52
3.19	View menu	52
3.20	Icon of View menu in the tool bar	53
3.21	Interface of Identify Result	53
3.22	Marine Search menu	54
3.23	Interface of Vessel Location window	55
3.24	Interface of the Vessel's Location information	56
3.25	Workflow for linking Access Database to ADO	57
3.26	Interface of Medical Assisted list	58
3.27	Interface of Fire and Rescue list	59
3.28	Sub-menu of Help menu	60
3.29	Interface of About menu	60
3.30	Interface of Contact Us menu	61
4.1	Interface of main display	63
4.2	Interface of map display	64
4.3	Information of About menu	65
4.4	information of Contact Us menu	65
4.5	Zoom In interface	68
4.6	Zoom Out interface	69
4.7	Zoom Extent interface	70
4.8	Interface of identify results with the attribute of spatial data	71
4.9	Status Bar	72
4.10	Example of adding a layer to the map display	73
4.11	Example of a contour layer that is removed	74
4.12	Symbol Properties layer tab	75
4.13	Symbol Properties of the Lighthouse layer	76

4.14	The results after editing Lighthouse in Symbol Properties	76
4.15	Percentage of system evaluation	78
4.16	The ability of the system display vessel on the map	79
4.17	Interface of Vessel Location Main window	79
4.18	The information about the vessel location	81
4.19	The example of the add and vessel information data	82
4.20	Injuries from mooring incident (Source: International Marine Contractor Association, Safety Flash, April 2009)	83
4.21	The information of Hospital list menu	84
4.22	The information of Fire and Rescue menu	86

LIST OF ABBREVIATIONS

ADO – ActiveX Database Object
AIS – Automatic Identifier System
API – Application Programming Interface
BASIC - Beginners All Purpose Symbolic Instruction Code
CAD – Computer Aided Drawing
CZM – Coastal Zone Management
DAO – Database Active Object
DBMS – Database Management System
DGPS – Differential Global Positioning System
ECDIS – Electronic Chart Display
ECS – Electronic Chart System
ENC – Electronic Navigational Chart
EPIRB - Emergency Position-Indicating Radio Beacon
ESRI – Environmental System Research Institute
GIS – Geographic Information System
GMDSS – Global Maritime Distress and Safety System
GPS – Global Positioning System
GUI – Graphical User Interface
HIS – Hydrographic Information System
HTML – Hypertext Markup Language
IHO – International Hydrographic Organization
IMO – International Marine Organization
MMEA – Malaysian Maritime Enforcement Agency
MRCC – Maritime Rescue Coordinating Center
MRSC – Maritime Rescue Sub-Center
MRI – Marine Research Infrastructure

MSRR – Malaysian Maritime Search and Rescue Region

MSI – Maritime Safety Information

MSDI – Marine Spatial Data Infrastructure

NGDI – National Geospatial Infrastructure

ODBC - Open Database Connectivity

RMN – Royal Malaysian Navy

SAR – Search and Rescue

SDI – Spatial Data Infrastructure

SENC – System Electronic Navigational Chart

SOLAS – Safety of Life at Sea

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	List of Questionnaires for Development of Maritime Rescue Application System	94-96
B	Entity Relationship Model	97
C	Interface Programming Code	98-149
D	Form Programming Code	150-163
E	Module Programming Code	164-169
F	List of Feedback Questionnaires for Development Of Maritime Rescue Application System	170-171